Remote Sensing of Soil Moisture in the Yuma, Arizona, Area

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The purpose of this investigation is to test the integration of Department of Defense high resolution National Technical Means (NTM) imaging assets with current methodology for improving assessments and operations of irrigation district water conservation and management programs, specifically in the area of soil moisture management.

Soil moisture management is an important component of irrigation water management. Timely and accurate measurement of the spatial distribution of soil moisture is important to overall effectiveness and efficiency of an irrigation district's water management program. Conventional measurement methods from a ground perspective may fail to capture spatial distribution of soil moisture. Areal photography, though providing a better spatial overview of an irrigation system, is expensive and may not be available on a regular basis. Conventional satellite imaging also lacks the resolution needed for detailed assessments.

Soil moisture spatial distribution varies greatly with elevation, soil type, and exposure in the complex terrain of western watersheds; thus, timely high resolution imaging of soil moisture obtained through the NTM program could potentially provide valuable information to irrigation district managers' estimates of real-time soil moisture conditions. This investigation will also examine the feasibility of using these assets for timely imaging, analysis, and reporting of results in a usable format to assist end-users (irrigation districts and irrigators) to better use soil moisture information in the management of their systems.

A coordinated approach of Department of Defense satellite imaging systems (various sensors), coupled with ground-truthing, has been a requirement of this study. Image processing is being conducted by Reclamation personnel with appropriate clearances.

A study area was selected near Yuma, Arizona, that met predetermined imaging criteria. This site has an existing system of soil moisture data measurement. Ground-truth data from the site are being integrated with image processing to develop a map of estimated soil moisture conditions for each imaging event. Each event will serve as a calibration by comparing ground truth data to image processed data.

If proven successful, procedures will need to be developed to ensure that imaging (data collection), image processing (data analysis), and reporting of results are handled in a timely manner and that results will be in a usable and understandable format for district and irrigator use. The final product of this investigation will be development of a methodology for determining soil moisture conditions in the field during critical dry periods of

the year. The intent of this product will be a system that can be implemented at the field level and be accomplished by irrigation district personnel.

The objectives of this project were to test the ability of measuring soil moisture from remote platforms. If proven technically effective and economically feasible, this research will benefit daily, weekly, and monthly irrigation water management operations. It could permit more effective use of available water for irrigated agriculture and potentially promote higher crop yields due to more precise soil moisture management. Reclamation, the Forest Service, Soil and Water Conservation Districts, irrigation districts, and other water management entities could all benefit from this project.

To date, the initial data collection has taken place. One lesson learned by the collection process is the difficulty of arranging data collection by National Technical Means. Problems encountered are interagency concerns of how data will be used and protection of source data. One solution to this dilemma would be the use of commercial systems now coming on line. The NTM process and bureaucracy may not make operational functionality feasible; however, commercial systems could overcome this obstacle but may be limited due to cost.

At the end of FY 1999, ground-truthing data were not yet available. When delivered, the analysis portion of this investigation will begin. Initial reaction to remotely sensed data was that soil moisture variability was detectable to a degree; however, vegetation in the study area may actually hamper interpretation of data.

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